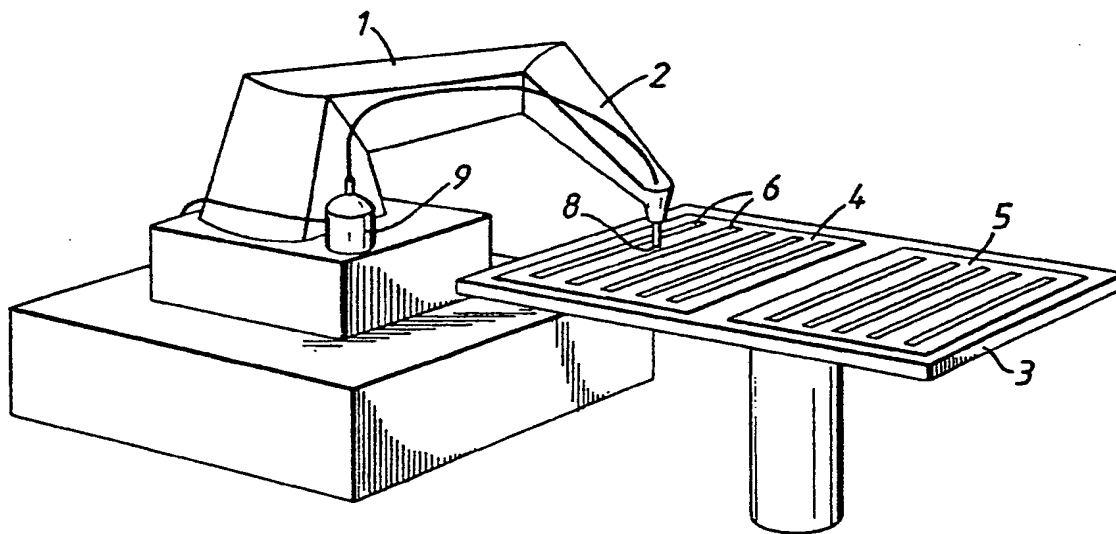


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>4</sup> : <b>H05K 3/28</b>	<b>A1</b>	(11) International Publication Number: <b>WO 86/ 03366</b> (43) International Publication Date: <b>5 June 1986 (05.06.86)</b>
<p>(21) International Application Number: PCT/GB85/00541</p> <p>(22) International Filing Date: 25 November 1985 (25.11.85)</p> <p>(31) Priority Application Number: 8429754</p> <p>(32) Priority Date: 24 November 1984 (24.11.84)</p> <p>(33) Priority Country: GB</p> <p>(71) Applicant (for all designated States except US): PLESSEY OVERSEAS LIMITED [GB/GB]; Vicarage Lane, Ilford, Essex IG1 4AQ (GB).</p> <p>(72) Inventors; and (75) Inventors/Applicants (for US only) : WALLACE, Christopher [GB/GB]; 21 Lysander Close, Christchurch, Dorset (GB). SIBLEY, Mark [GB/GB]; 75 Meadow-sweet Road, Centurions Way, Creekmoor, Poole, Dorset (GB).</p> <p>(74) Agent: NICHOLSON, Ronald; The Plessey Company plc, Intellectual Property Department, Vicarage Lane, Ilford, Essex IG1 4AQ (GB).</p>		<p>(81) Designated States: AT (European patent), AU, BE (European patent), CH (European patent), DE (European patent), FR (European patent), GB (European patent), IT (European patent), JP, KR, LU (European patent), NL (European patent), SE (European patent), US.</p> <p><b>Published</b> <i>With international search report.</i></p>

(54) Title: IMPROVEMENTS RELATING TO PROTECTIVELY COATING ELECTRICAL EQUIPMENT



## (57) Abstract

A method of applying a protective coating to an electronic panel having a multiplicity of rows of electrical connectors or other electrical components mounted thereon, characterised in that the regions of the panel between the rows of electrical connectors or other electrical components are protectively coated by means of an injection process in which coating material of accurately controlled consistency and volume is fed under pressure through a nozzle accurately located in predetermined spaced relationship with the panel surface and between rows of said connectors or other components whilst the panel and nozzle are moved at a predetermined speed and in predetermined positional relationship relative to one another.

BEST AVAILABLE COPY

***FOR THE PURPOSES OF INFORMATION ONLY***

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	GA	Gabon	MR	Mauritania
AU	Australia	GB	United Kingdom	MW	Malawi
BB	Barbados	HU	Hungary	NL	Netherlands
BE	Belgium	IT	Italy	NO	Norway
BG	Bulgaria	JP	Japan	RO	Romania
BR	Brazil	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic	KR	Republic of Korea	SE	Sweden
CG	Congo	LI	Liechtenstein	SN	Senegal
CH	Switzerland	LK	Sri Lanka	SU	Soviet Union
CM	Cameroon	LU	Luxembourg	TD	Chad
DE	Germany, Federal Republic of	MC	Monaco	TG	Togo
DK	Denmark	MG	Madagascar	US	United States of America
FI	Finland	ML	Mali		
FR	France				

-1-

IMPROVEMENTS RELATING TO PROTECTIVELY COATING  
ELECTRICAL EQUIPMENT

This invention relates to methods of applying protective coatings to electrical equipment for the protection of such equipment against adverse environmental conditions. More specifically the invention is directed to the coating of so-called multi-layer back plane panels and other electronic panels having a multiplicity of rows of electrical connectors or other electrical components mounted thereon.

According to one known method of applying such protective coatings to back plane panels on which are mounted rows of printed circuit board edge connectors the panel is dipped into a bath of coating material (e.g. HUMISEAL 1B31) after masking certain regions of the panel or components mounted thereon as required. The dipping operation ensures that the panel surface including those areas between the edge connectors are adequately coated but that the depth of dipping does not cause the coating material to enter the board receiving ends of the connectors. However, it has been found that due to capillary action coating material has penetrated and risen up into certain interstices of the edge connector bodies from the panel surface end of the connectors and thereby caused electrical contact problems in such connectors.

-2-

According to the present invention the aforesaid problems due to capillary action occurring during dipping operations are avoided by protectively coating the regions of the panel between rows of electrical connectors or the like by means of an injection process in which protective coating material of accurately controlled consistency and volume is fed, preferably injected under pressure, through a nozzle accurately located in predetermined spaced relationship with the panel surface and between rows of said connectors or the like whilst the panel and injection nozzle are moved at a predetermined speed and in predetermined positional relationship relative to one another.

The accurate control of the consistency and volume of the protective material dispensed by the nozzle together with the positioning of the nozzle and the relative speed of movement between the nozzle and the panel being coated ensure that just the right amount of protective material is applied to the panel surface between the connectors or the like to allow the material to spread out and provide an adequate protective coating on the panel surface without any surplus being available to rise up through the connector bodies by capillary action as previously described.

The present invention lends itself admirably to

-3-

computer-controlled robotic application of the protective coating material through a syringe injection nozzle carried by a movable robot arm which will be controlled so that it moves in accordance with a suitable computer program relative to one or more stationary electronic panels to be coated so that the syringe nozzle moves to and fro along the channels defined between respective rows of edge connectors.

By reason of the accurate control which can be exercised during the coating operation the present invention ensures high quality of the protective coatings as well as good efficiency and repeatability of the coating operation under computer controlled conditions. Computer control of the process also affords good flexibility and process capability by appropriate choice of computer programs.

Other areas of the panel and/or components moulded thereon, either before or after application of protective coating material by the injection process of the present invention, may be coated by spraying coating material on to these areas and/or components through a suitable spray gun.

By way of example the present invention will now be described with reference to the accompanying drawing in which:

-4-

Figure 1 shows a perspective diagrammatic view of a computer-controlled robot machine for applying protective coating material to multi-layer back plane panels; and,

Figure 2 is a fragmentary diagrammatic view showing an injection nozzle carried by the robot machine arm and located between adjacent rows of electrical connectors.

Referring to the drawing, the robot machine 1 includes a movable arm 2 and is located in predetermined positional relationship with a work support table 3 which can be rotated through 180° in the horizontal plane, as required, for the selective positioning of multi-layer back plane panels 4 and 5 supported by the work table 3 relative to the robot arm 2.

As can be seen from Figure 2, each of the back plane panels comprises rows of electrical connectors 6 between which protective coating material is required to be applied to the surface 7 of the panel. In order to apply such material so that the requisite protection is afforded without the risk of surplus coating material rising up through interstices of the electrical connector bodies due to capillary action as has been the case when dipping procedures have been adopted for providing the protective coating, the present invention makes use of the robot machine 1 which is controlled by means of a computer suitably programmed so that the robot arm 2 which carries

-5-

an injection nozzle 8 moves along a path to and fro across the panel whereby the injection nozzle 8 moves along each channel in turn between adjacent rows of electrical connectors. Coating material (e.g. HUMISEAL 1B31) of accurately predetermined viscosity will be fed to the nozzle 8 from a reservoir 9 where the material is pressurised by means of a suitable inert gas (e.g. NITROGEN OR ARGON). The consistency of the coating material and the rate at which the material is dispensed by the nozzle 8 and the speed of movement of the nozzle along the channels between the connectors as well as the distance of the nozzle from the panel surface will all be accurately controlled in order to ensure high quality protective coatings.

After one of the panels (4) has been coated between connectors by the robot machine in accordance with the invention the work table 3 may be rotated automatically through 180° in order to present the other back plane panel (5) to the robot arm in readiness for coating.

After coating the second panel both panels 4 and 5 may be removed from the work table 3 and two further panels inserted in the support table in readiness for coating.

As previously mentioned other local areas of the back plane panels may be coated by spraying etc. as required before or after the panels are coated between the electrical connectors by means of the robot machine.

-6-

CLAIMS:

1. A method of applying a protective coating to an electronic panel having a multiplicity of rows of electrical connectors or other electrical components mounted thereon, characterised in that the regions of the panel between the rows of electrical connectors or other electrical components are protectively coated by means of an injection process in which coating material of accurately controlled consistency and volume is fed under pressure through a nozzle accurately located in predetermined spaced relationship with the panel surface and between rows of said connectors or other components whilst the panel and nozzle are moved at a predetermined speed and in predetermined positional relationship relative to one another.

2. A method as claimed in claim 1, characterised in that a computer-controlled robot controls the application of the protective coating material through a syringe injection nozzle carried by a movable robot and controlled so that it moves in accordance with a computer program relative to one or more stationary electronic panels to be coated so that the syringe nozzle moves to and fro along the channels defined between respective rows of electrical components.



-7-

3. A method as claimed in claim 1, characterised in  
that selected parts and/or components mounted on the board  
are coated with suitable coating material by spraying  
before or after the application of the coating material to  
5 the panel between the rows of electrical components.

1/1

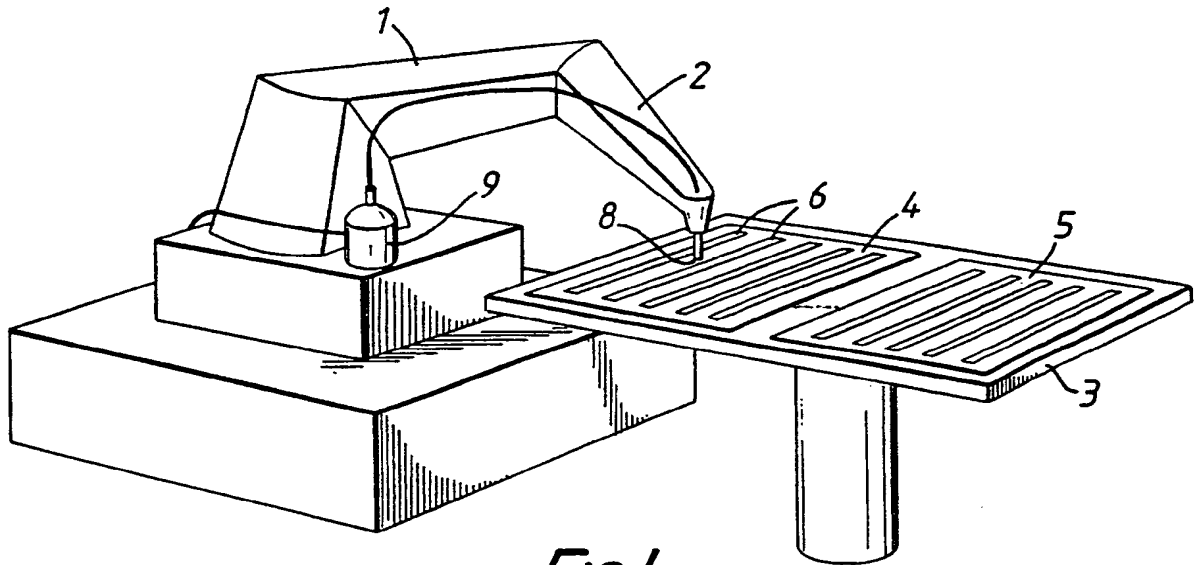


Fig. 1.

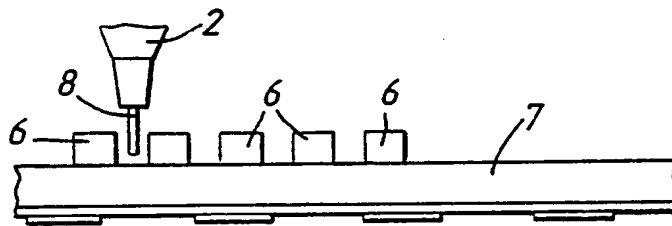


Fig. 2.

BEST AVAILABLE COPY

# INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 85/00541

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>6</sup> According to International Patent Classification (IPC) or to both National Classification and IPC IPC <sup>4</sup> : H 05 K 3/28														
<b>II. FIELDS SEARCHED</b> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black;">Minimum Documentation Searched <sup>7</sup></div> <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 25%; border-bottom: 1px solid black;">Classification System</th> <th style="width: 75%; border-bottom: 1px solid black;">Classification Symbols</th> </tr> <tr> <td style="border: 1px solid black; padding: 5px;">IPC<sup>4</sup></td> <td style="border: 1px solid black; padding: 5px;">H 05 K</td> </tr> </table> <div style="border-top: 1px solid black; padding-top: 5px;">           Documentation Searched other than Minimum Documentation to the extent that such Documents are Included in the Fields Searched <sup>8</sup> </div>			Classification System	Classification Symbols	IPC <sup>4</sup>	H 05 K								
Classification System	Classification Symbols													
IPC <sup>4</sup>	H 05 K													
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT <sup>9</sup></b> <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 10%; border-bottom: 1px solid black;">Category <sup>9</sup></th> <th style="width: 70%; border-bottom: 1px solid black;">Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup></th> <th style="width: 20%; border-bottom: 1px solid black;">Relevant to Claim No. <sup>13</sup></th> </tr> <tr> <td style="border: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="border: 1px solid black; padding: 5px;">GB, A, 1403776 (COMPULINE CORP.) 20 August 1975  --</td> <td style="border: 1px solid black;"></td> </tr> <tr> <td style="border: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="border: 1px solid black; padding: 5px;">IBM Technical Disclosure Bulletin, volume 7, no. 11, 11 April 1965 New York (US) W.M. Howard et al.: "Pressure-Vacuum Coating Device", pages 985,986  --</td> <td style="border: 1px solid black;"></td> </tr> <tr> <td style="border: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="border: 1px solid black; padding: 5px;">Patents Abstracts of Japan, volume 8, no. 264, (E-282)(1701) 4 December 1984, &amp; JP, A, 59134861 (HITACHI SEISAKUSHO K.K.) 2 August 1984  -----</td> <td style="border: 1px solid black;"></td> </tr> </table>			Category <sup>9</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>	A	GB, A, 1403776 (COMPULINE CORP.) 20 August 1975  --		A	IBM Technical Disclosure Bulletin, volume 7, no. 11, 11 April 1965 New York (US) W.M. Howard et al.: "Pressure-Vacuum Coating Device", pages 985,986  --		A	Patents Abstracts of Japan, volume 8, no. 264, (E-282)(1701) 4 December 1984, & JP, A, 59134861 (HITACHI SEISAKUSHO K.K.) 2 August 1984  -----	
Category <sup>9</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>												
A	GB, A, 1403776 (COMPULINE CORP.) 20 August 1975  --													
A	IBM Technical Disclosure Bulletin, volume 7, no. 11, 11 April 1965 New York (US) W.M. Howard et al.: "Pressure-Vacuum Coating Device", pages 985,986  --													
A	Patents Abstracts of Japan, volume 8, no. 264, (E-282)(1701) 4 December 1984, & JP, A, 59134861 (HITACHI SEISAKUSHO K.K.) 2 August 1984  -----													
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p><sup>10</sup> Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"Z" document member of the same patent family</p> </div> </div>														
<b>IV. CERTIFICATION</b> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border-bottom: 1px solid black; padding: 5px;">           Date of the Actual Completion of the International Search             29th January 1986         </td> <td style="width: 50%; border-bottom: 1px solid black; padding: 5px;">           Date of Mailing of this International Search Report   <div style="font-size: 1.2em; font-weight: bold;">17 FEB. 1986</div> </td> </tr> <tr> <td style="border-bottom: 1px solid black; padding: 5px;">           International Searching Authority             EUROPEAN PATENT OFFICE         </td> <td style="border-bottom: 1px solid black; padding: 5px;">           Signature of Authorized Officer  <div style="text-align: center; margin-top: 10px;"> </div> <div style="text-align: right; margin-top: 10px;">M. VAN MOL</div> </td> </tr> </table>			Date of the Actual Completion of the International Search  29th January 1986	Date of Mailing of this International Search Report  <div style="font-size: 1.2em; font-weight: bold;">17 FEB. 1986</div>	International Searching Authority  EUROPEAN PATENT OFFICE	Signature of Authorized Officer <div style="text-align: center; margin-top: 10px;"> </div> <div style="text-align: right; margin-top: 10px;">M. VAN MOL</div>								
Date of the Actual Completion of the International Search  29th January 1986	Date of Mailing of this International Search Report  <div style="font-size: 1.2em; font-weight: bold;">17 FEB. 1986</div>													
International Searching Authority  EUROPEAN PATENT OFFICE	Signature of Authorized Officer <div style="text-align: center; margin-top: 10px;"> </div> <div style="text-align: right; margin-top: 10px;">M. VAN MOL</div>													

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON

INTERNATIONAL APPLICATION NO. PCT/GB 85/00541 (SA 11374)

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 08/02/86

The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB-A- 1403776	28/08/75	US-A- 3961599	08/06/76

For more details about this annex :  
see Official Journal of the European Patent Office, No. 12/82